APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM

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Field of Invention

The present invention relates to an apparatus and method for producing a polyolefinic transpiring (semipermeable) film, capable of allowing vapour and air to pass therethrough while being impermeable to liquids.

The Prior Art

~~The patent~~ EP 0.283.200 B1, to which reference is made for a general understanding of the prior art, describes a method for producing transpiring films in which an extruded linear low density polyethylene ~~extrusion at low density~~ (LLDPE), ~~charged with~~ containing $CaCO_3$, is first heat-embossed~~, for providing~~ to provide reduced thickness imprints, and then stretched to obtain a transpiring film with a particularly elevated transpirability in the reduced thickness zones.

Transpiring films according to the prior art ~~moreover~~ have various problems and drawbacks. One problem which is encountered in known polyolefinic transpiring films is the possible formation of micro-holes during the stretching ~~phase~~ of the film, which formation is due to the presence of impurities, in particular oxidised and carbonised particles.

Such impurities may already be present in the mix to be extruded, or they may form during the extrusion ~~process~~ of the polyethylene.

The micro-holes, which have an average diameter between 0.2 and 2 mm, may compromise the liquid impermeability characteristics; ~~such~~ which risk increases with the speed of the stretching process and with ~~the~~ increase in the degree of stretching of the film.

Another problem which is encountered in polyolefinic transpiring films is the non-uniformity of the transpirability.

SUMMARY OF THE INVENTION

Accordingly, ~~A~~ a principle ~~aim~~ objective of the present invention is to provide a method and an apparatus for producing a polyolefinic transpiring film which ~~allow to~~ overcome at least part of the above cited problems.

~~Such aim is obtained by means of a method in accordance with the claim 1 and by means of a plant in accordance with claim 4.~~

(insert from claims)

CLAIMS

Accordingly, the present invention provides a method

1 Method for producing polyolefinic transpiring films comprising the steps of:

bubble extruding a mix of ~~charged LLDPE~~, a polyolefin and a filler to form a tube which allows vapour and air to pass therethrough while being impermeable to liquids, the method having two layers;

flattening the ~~tubular (10) in order~~ tube to obtain a flat film double layer (11);

heating the flat film ~~(11) up~~ to its softening temperature;

compressing the flat film double layer ~~(11)~~ to unite the layers of the double layer flat film;

cooling the flat film to a temperature between 8-30 °C; and

~~transversal~~ Transversely and/or longitudinal stretching of the flat film double layer ~~(11)~~ To impart transpirability.

~~2. Method, according to claim 1, wherein~~ The heating of the flat film ~~(11) is~~ may be first ~~heated~~ by conduction and ~~then successively~~ by irradiation.

In another aspect the present invention provides an apparatus

~~3. Plant~~ for producing a stretched polyolefinic film comprising, in ~~succession~~ series:

a bubble extruder ~~(1)~~;

a first calender ~~(2) adapted to~~ for flattening the extruded ~~tubular~~ tube to form a double layer flat film having two layers;

means ~~(3,4) adapted to~~ for heating the flat film ~~(11) up~~ to its softening temperature;

a second calender ~~(5) adapted to~~ for compressing the heated double layer flat film to unite the two layers;

means ~~(5) adapted to~~ for cooling the film quickly cool the double layer flat to a temperature ~~comprised~~ between 8-30 °C; and

means ~~(6) adapted to transversally stretch the film~~ and/or ~~means (8) adapted to~~ for stretching Transversely and/or longitudinally stretching the film to form double layer flat.

~~4. Plant, according to claim 3, wherein said means adapted to heat the flat film (11) comprise, in succession:~~

The heating means may include

first heating means, adapted to heat the film by conduction; and

second heating means adapted to heat the film by irradiation.

~~Further embodiments of the method may be carried out in accordance with the dependent claims~~ BRIEF DESCRIPTION OF THE DRAWING

~~2 and 3, and further embodiments of the plant may be carried out in accordance with the~~ The sole drawing figure is a schematic view illustrating apparatus as utilized in practice of the method of the present invention.

~~dependent claims 5 and 6.~~ DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and the apparatus according to the invention will appear in a clear manner from the following description of one ~~possible~~ embodiment, provided ~~in a~~ purely ~~indicative manner~~ as an example, ~~together~~ with reference to the drawing figure which shows, in a schematic view, a manufacturing plant in accordance with the invention.

The present method provides for the use of a mix preferably of linear polyethylene ~~at~~ low density (LLDPE) charged with ~~a base of~~ $CaCO_3$.

~~Alternatively,~~ It is possible to use either linear polyethylene ~~at~~ low density (LLDPE) or polyethylene ~~at~~ ~~medium~~ density (MDPE) medium density.

It is also possible to use copolymers of ~~poly~~ethylene ~~having~~ and an α-olefin with 4-10 atoms of carbon (~~1~~-butene, 1-pentene, ~~1-esene, 1-eptene, 1-ottene, 4 metil, 1 pentene~~ 1-hexene, 1-heptene, 1-octene).

Naturally, it is also possible to use other ~~types of charges~~ fillers, organic or inorganic, having dimensions between 0.6 and 6 μm and treated in a way to render their surfaces hydrophopic.

In particular, it is possible to use: clay, kaolin, zeolite, Zn, Al, Ca, $CaSO_4$, $BaSO_4$, MgO, $Mg(OH)_2$, TiO_2.

The ~~quality~~ quantity (charge) of the ~~added~~ filler charge depends also on the degree of desired traspirability, normally the ~~charge~~ filler constitutes from 30% to 70% by weight of the mix.

Such mix is bubble-extruded (so-called blow moulding), by means of a circular-head extruder 1 in order to obtain a ~~tubular~~ tube 10.

The temperature of the ~~tubular~~ tube exiting ~~from~~ the extruder 1 is between 150-230°C and, preferably, between 170-190°C.

The ratio of expansion of the ~~tubular~~ tube 10 may vary between 1:2 and 1:4, and preferably is 1:3.

One characteristic of the method of the present invention is the fact that the extruded and expanded ~~tubular~~ tube 10 is subjected to a calendering operation.

In detail, the ~~tubular~~ tube 10 enters, at a temperature of about 80-100°C, ~~in~~ a first calender 2 where it is compressed and stretched into the form of a sheet 11, ~~constituted by~~ of two superimposed layers, assuming a width equal to half of the circumference of the ~~tubular~~ tube and a thickness which is double ~~with respect to~~ the thickness of the ~~tubular~~ tube.

No → Such ~~characteristic~~ a process has the advantage of resolving the problem of insufficient liquid impermeability due to the micro-holes which may form in the films during the stretching ~~phases~~ because it is ~~in fact~~ extremely improbable that both the layers of the film ~~are~~ will be damaged at the same point.

The calender 2 used for flattening the ~~tubular~~ tube 10 comprises a pair of smooth coupled rollers of which the first one is chromed steel and the second one is rubber with a hardness of 60-80 shore.

The pressure supplied by the calender 2 on the flattened ~~tubular~~ tube 10 varies between 5 and 10 kg/cm2.

A second characteristic of the method according to the invention ~~consists in the fact~~ is that after having been flattened, the film 11 is heated ~~up~~ to its softening temperature.

Such temperature depends on the type of mix which is extruded, in the case of an LLDPE base mix it may vary between 80 and 130 °C and usually, it is around about 100 °C.

The heating executed in this manner favours the removal of ~~humidity or of~~ moisture and additives present in the mix which have a low evaporation point.

Moreover, the heating executed in this manner favours the elimination of micro-stresses present in the film due to the preceding ~~phases~~ steps of the method and favours ~~the~~ homogenization of the internal structure of the film.

~~In order to obtain the~~ For heating, the film 11 is first ~~made to~~ run on heated rollers 3, having a temperature of about 60-70 °C, and then ~~made to~~ pass ed near infrared ray lamps 4 which further increase the temperature up to the point ~~of~~ softening.

In fact the use only of ~~the~~ heated rollers - normally heated with water or oil - does not allow the film to reach ~~the~~ its softening temperature, or at least ~~with~~ not without great difficulty.

~~Moreover,~~ the infrared lamps provide the advantage of ~~also~~ strongly heating the layer of air about the film 11 (typically up to 300-400 °C) which ~~therefore permits to~~ completely eliminate the residual humidity still present on the film 11.

A third characteristic of the method according to the invention consists in the fact that the film heated in this manner is further calandered by a calender 5 and, thereafter, cooled to a temperature between 8 and 30 °C.

Such cooling is carried out, preferably, through contact ~~by means of~~ one of the rollers of the calander 5, which is maintained at a constant temperature between 8 and 30 °C.

The further calendering ~~permits~~, through the compression provided by the rollers, ~~to~~ intimately unite the two original layers so as to avoid the risks of de-lamination of the film produced in this manner, and the thermal shock to which the film is subjected ~~permits to block~~ the stabilization process.

It is also possible, in this phase, to ~~carry out an~~ embossing ~~operation of~~ the film for a purely aesthetic purpose which does not modify the weight of the film.

It has been found that the thermal shock to which the film is subjected ~~allows to obtain an~~ improved transpirability during the successive stretching operations.

The compression of the film is obtained by coupling a chromed-steel roller ~~coupled~~ with a rubber roller (hardness 60-80 shore).

~~Successively to~~ the process of sterilization, the film 11 is subjected to transverse and/or longitudinal stretching.

For such purpose, ~~there are present~~ appropriate means 6 adapted to carry out the transversal stretching and appropriate means 8 adapted to carry out the longitudinal stretching.

In the illustrated example, the film 11 is subjected first to a transversal stretching and then to a longitudinal stretching, naturally these ~~phases~~ may ~~also~~ be ~~inverted~~.

Preferably between the transversal stretching means 6 and the longitudinal stretching means 8 there are provided tentering means 7 for eliminating the folds created by the first process of stretching.

Normally, the ratio of longitudinal stretching varies between 1:1.5 and 1:2.5.

Also in this manner, the ratio of longitudinal stretching varies, usually, between 1:1.5 and 1:2.5.

However, if required, the ratio of stretching may ~~also arrive to a ratio of~~ be up to 1:4.

At the end of the stretching ~~phase~~, the film 11 may undergo further working steps or be wound up by an appropriate winding machine 9.

ABSTRACT

The invention relates to a method and a plant for producing polyolefinic transpiring films by means of bubble extrusion of a ~~charged~~ LLDPE mix, flattening of the extruded ~~tubular in order~~ to obtain a flat film and transversal and/or longitudinal stretching of the flat film.